

APPLICATIONS FOR INCREMENTAL MAGNETIC TAPE RECORDERS

SUMMARY

There are now approximately one dozen different makes of magnetic incremental stepping recorders on the market -- and most have been introduced only within the past year. There is considerable speculation among users and manufacturers alike regarding the use and future of these magnetic "steppers". This article briefly explores the reasons why steppers are finding widespread application in data logging, digital data transmission and data processing.

WHAT ARE MAGNETIC STEPPERS? Magnetic steppers are devices which record digital data on magnetic tape character-at-a-time with constant bit or character spacing. Unlike computer tape transports which require constant data rate and fixed tape speed, steppers record asynchronously (character-at-a-time) to maintain constant packing density. (Generally this is 200 characters per inch.) Steppers advance tape only on receipt of a digital character and record information received at any rate (fixed or variable) from 1 to 300 cps.

BACKGROUND. The tremendous growth of the computer industry is already a matter of record. By 1970, installations should more than double from their present 18,000 to more than 40,000. The widespread use and future of automatic digital data equipment for information storage, transmission, record keeping, and management decision-making is accepted without question.

Also apparent is the growing need to provide an economical means by which computerized operations can communicate with each other. Accordingly, Bell has introduced Data-Phone service which makes high-speed digital data transmission (DDT) available at reasonable cost to all on an exchange (dial-up) basis. The growth of DDT is dramatic -- it is conservatively estimated that the number of Data-Phone data set installations will increase from the present 10,000 to 100,000 or more by 1970. Presently, this system uses perforated paper tape as its data storage media. Paper tape readers and perforators are employed to transmit and record digital data asynchronously (character-at-a-time) in the form of punched code holes in paper tape.

However, the use of paper tape devices for high-speed (100 to 300 cps) data transmission is not ideal for many applications -- particularly at 200 and 300 cps. Reason? (1) cost of paper tape perforating at the higher speeds is excessive -- for both equipment and maintenance costs. (2) paper tape usage high due to low packing density. (3) paper tape not reusable. (4) reliability of perforators at 200 to 300 cps questionable. (5) not compatible with computer magnetic tape formats.

Magnetic steppers have been developed to overcome these disadvantages. Functionally identical to paper tape perforators, these asynchronous magnetic tape recorders appear to offer economical, reliable, reusable recording at speeds up to 300 cps. Magnetic steppers can record directly in computer compatible machine language thereby eliminating secondary conversion when computer input is required. Other magnetic steppers employ sprocketed magnetic tape, hence are not directly compatible with computer tape formats.

However, these non-compatible steppers provide the advantages of tape re-usability, high packing density, and increased reliability at high data rates.

APPLICATIONS AND MARKETS

The prime applications for magnetic steppers are:

- o data communications
- o computer I/O
- o data encoding and printout
- o data collection
- o numeric and process control

Data Communications. Magnetic steppers fill an equipment hardware gap between paper tape "teletype" read-punch terminals and high-speed computer magnetic tape transports. As described earlier, the future of data processing and data transmission is very bright. But more important is the fact that paper tape devices are not ideally suited as a communications interface between data transmission data sets and computer mainframe or memory. Magnetic tape recording offers advantages over paper tape readers and perforators -- particularly in those instances where IBM compatibility is required along with increased reliability, improved cost-to-performance, and reusable media. While the military and civilian agencies of the U.S. Government are the most immediate potential for magnetic steppers, commercial and industrial DDT applications will use thousands of steppers in the years to come.

Computer I/O. IBM-compatible steppers, particularly those with a read/write, synchronous-asynchronous capability are well-suited to computer I/O and monitor. The wide speed range of these devices (from 1 cps asynchronous to 7200 cps synchronous) and read/write ability is of considerable value for this application.

Sprocketed magnetic tape and other "non-compatible" steppers are now beginning to be used in replacement of paper tape reader-punch units on small "desk-top" computers.

These versatile devices will find application wherever a single device is required for direct unbuffered linkage between computer and low-speed, character-at-a-time devices. Computer manufacturers who make computers for teleprocessing and paper tape I/O will be interested in magnetic stepper drives.

Data Encoding & Printout. Getting data into computer language is often troublesome. The most convenient methods employed prior to magnetic steppers were via punched card and punched tape. Steppers properly interfaced for I/O with data typewriters now provide an efficient, electromagnetic method of computer entry and asynchronous, hard-copy printout. Prime applications include magnetic tape oriented computer systems which now rely on punched paper tape input for data entry. Hard-copy printout on character-at-a-time basis is an economical means for slow-speed computer monitor.

Data Logging. By nature, much data occurs or is transmitted sporadically. Seismographic and weather reporting information are typical of this type of data. Data collection from various digital measuring devices and A to D convertors are other examples of remote data collection. Magnetic steppers are particularly well-suited to remote data recording. Depending upon end-use of this data, either compatible or non-compatible steppers should be used.

Numeric and Process Control. Tape controlled machine tools are increasing rapidly. While past convention has called for perforated paper tape, the use of magnetic steppers is becoming more prevalent for automatic point-to-point

and particularly automatic contour-control machines. IBM-compatible tapes permit control tapes to be prepared directly by the computer. Some manufacturers of machine tools and machine tool controls are employing cartridge tape to facilitate handling.

TYPES OF MAGNETIC STEPPERS

While there are many different types of magnetic steppers on the market today, three main categories exist:

Non-compatible Steppers. These steppers are relatively low-cost incremental recorders which provide all the advantages of magnetic tape at recording speeds up to 300 cps. IBM compatibility is a trade-off for lower price. These steppers are generally provided with read as well as write capability and come equipped with either tape loops or cartridges. Two stepper designs use sprocket feed with 16 or 35 mm magnetic tape. Packing density is generally in 60 to 100 characters per inch range. Typical of non-compatible steppers is the TRAK Electronics' DS-1.

These non-compatible magnetic steppers are being used in a wide variety of buffering applications between digital systems of different speed capabilities. (See Figure 1.) An example of a buffer-store application is the tying together of a 10 cps "teletype" (100 wpm) system and 200 cps (2000 wpm) Data-Phone system, where different data rates of the systems makes direct connection impossible.

Other applications include replacement for paper tape readers and perforators where there is need for speeds up to 300 cps, reusable media and high packing density at reasonable cost.

IBM-Compatible Recording Stepper. This type of stepper records random digital data on standard IBM 1/2-inch wide 7 channel tape with standard packing density (generally 200 characters per inch) and 7 channel NRZ-1 recording. Provision is made for gap insertion (inter-record, end-of-file) tape marks (BOT and EOT) and longitudinal parity check characters. The completed "compatible" tape reel is removed from stepper and mounted on IBM 729 series tape drive for high-speed playback to computer memory or other tape drives. Reading or playback is not furnished. Typical of IBM compatible, record-only steppers is Precision Instrument's RSL-150-7. (See Figure 2.)

IBM-compatible, record-only steppers are well-suited to applications where preparation of tape is remote from computer processing center and where time permits tape to be sent in for processing at the higher data transfer rates. Examples of typical record-only stepper applications are data encoding into IBM format from I/O typewriters and incremental recording of temperatures, pressures in standard IBM format.

IBM-Compatible Read-Write Stepper-Drives. Read-write stepper-drives function as any fast start-stop computer tape drives with packing densities of 200 bpi and transfer rates up to 7200 cps. In addition, this versatile unit provides character-at-a-time recording and playback from 1 to 300 cps. The following characteristics are provided:

- o read and write synchronously at speeds up to 7200 cps
- o read and write asynchronously at speeds from 1 to 300 cps
- o write synchronously for asynchronous readout
- o record information in IBM-compatible format
- o generate inter-record and end-of-file tape gaps at high speeds

Thus, in one package, a wide variety of recording and playback speeds are possible on either incremental or continuous basis. Such versatility allows the stepper-drive (with simple interface electronics) to be used for digital encoding from data typewriters as well as direct tie-up with computer memory. Representative of this new type of recorder is Potter Instrument's new MTB-1501 RW read-write stepper-drive. (See Figure 3.)

The IBM-compatible read-write stepper-drive is ideally suited for data buffering and interface between slow-speed asynchronous devices and high-speed IBM-compatible synchronous devices. These units will be used where there is need for IBM-compatible read/write capability and direct computer I/O.

MODEL MTB-150IS

MAGNETIC INCREMENTAL TAPE TRANSPORT

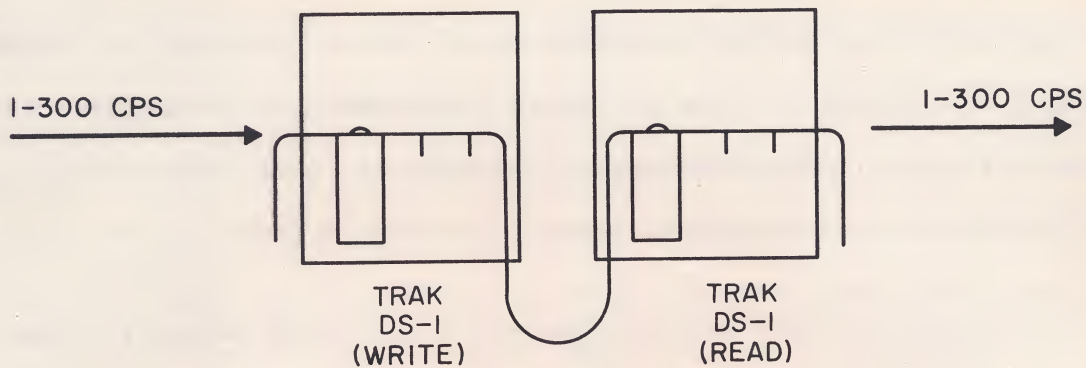


FIGURE 1.
NON-COMPATIBLE STEPPER

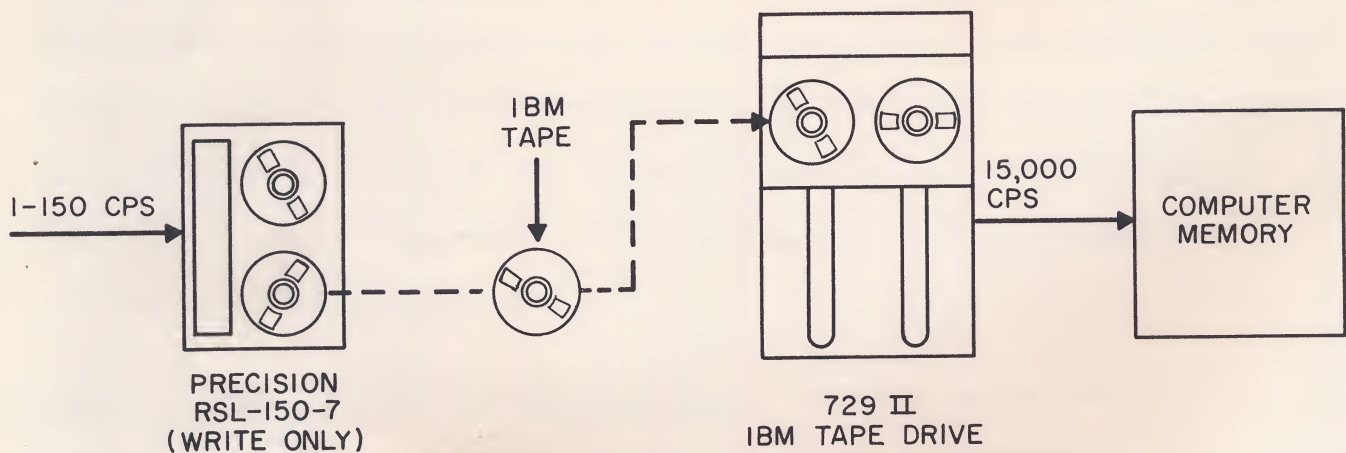


FIGURE 2.
IBM-COMPATIBLE RECORDING STEPPER

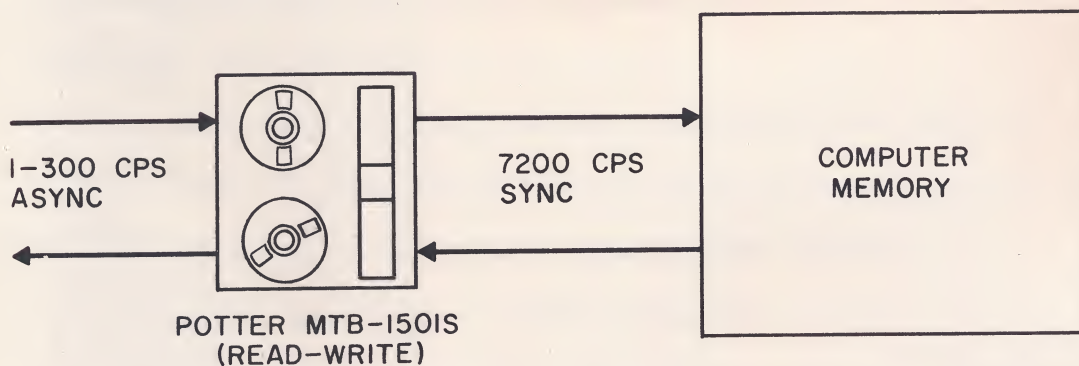


FIGURE 3.
IBM-COMPATIBLE READ/WRITE STEPPER-DRIVE